

WILLIAM MAXWELL REED

MECHANICAL ENGINEERING SEMINAR

The Role of Atomic Scale Mechanisms on Stress Evolution and Pattern Formation in Ion-bombarded Silicon

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Abstract: This talk presents the effect of atomic scale mechanisms, caused by ions bombarding a silicon surface, on stress evolution and on the surface instability that leads to nanometer-scale surface pattern formation. Ion bombardment serves as a useful nanomanufacturing procedure to make/alter MEMS devices, optical gratings, and nanomechanical templates. Control of stresses and surface structures are critical in most MEMS and nanoscale devices created by ion bombardment. Argon ion bombardment of silicon with ion energies of 500eV, an energy that is typical in pattern formation experiments, are studied using Molecular Dynamics (MD) simulations. An interplanar mechanical definition of atomic-scale stress shows the existence of 1-2GPa stresses near the surface. An impact response function representing the continuum change in surface height due to an average ion impact at a random surface point is also computed to study pattern formation. Simulations using statistically averaged impact response functions (called crater functions) and continuum diffusion equations demonstrate nanometer-scale pattern formation on micron-sized silicon surfaces. The long-time pattern heights obtained from these multiscale simulations explain experimental observations better compared to mechanisms that only include sputter effects. The nanoscale mass rearrangement mechanism explains these observations and suggests significant deviations from sputter-only pattern formation theories.

Bio: Nagarajan (Naga) Kalyanasundaram is an MIE Outstanding scholar and Computational Science & Engineering Fellow at the University of Illinois at Urbana-Champaign. He joined Illinois in August 2003 and works on pattern formation on silicon surfaces due to ion bombardment. He received his Bachelor of Technology in Mechanical Engineering and Master of Technology in Mechanical Engineering (Product Design) from the Indian Institute of Technology, Madras in 2003. His research interests are in the areas of mechanics and optoelectronics of materials at nanoscale, nanomanufacturing and biomolecular simulations. His research consists of computational analysis of nanoscale physics and employs atomistic simulation methods to extract useful information for bridging length and timescales.

Date: Thursday, March 01, 2007

Time: 3:30pm to 4:30pm (refreshments 3:00pm)

Place: Room 323 CRMS Bldg.

Contact: Dr. Marwan Khraisheh 859-257-6336 ext. 80662

Meet the speaker and have refreshments
Attendance open to all interested persons



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